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(54) **PAPER MACHINE FOR THE MANUFACTURE OF HIGH BULK SOFT CREPE PAPER.**

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Description

Technical Field

The present invention relates to a paper machine for the manufacture of soft crepe paper and including a wire section, which has at least one forming fabric loop for forming a paper web, and a drying section including a Yankee dryer, in which drying section the paper web is dried, said paper machine having a first operative design for the manufacture of soft crepe paper having certain measurements of bulk and softness, in which first operative design a press section located between the wire section and the drying section has a felt movable in an endless loop and arranged to run from a pick-up device located at a transition between the wire section and the press section to a press roll forming a nip with the Yankee dryer while carrying the paper web on its under side, the carrying forming fabric being arranged to run up to said pick-up device in the press section for the transfer of the formed paper web to said felt (US-A-4 144 124).

Background Art

Conventional soft crepe paper machines of the above kind are widely known, see U.S. Patent No. 4,055,461, for example. The soft crepe paper manufactured in such machines has certain limited values for bulk and softness. To achieve bulk and/or softness values above these limited values, special methods have been utilized, such as mixing in expandable microspheres of thermoplastics as disclosed in U.S. patent No. 4,619,734, or utilizing machines operating with through-air drying by means of hot air, see U.S. Patent Nos. 3,303,576, 3,812,000, 3,821,068 and 4,036,684, for example, where the through-air drying is carried out on cylinders having a perforated shell, which may be covered by a fabric, for example, and where hot drying air is supplied internally and passes out through the shell or the reverse.

However, the known conventional soft crepe paper machines of twin wire, fourdrinier, or breast roll former type are designed in such a way that they can not readily be converted into different operative designs for making it possible to manufacture soft crepe paper grades of considerably different requirements for bulk and softness.

Disclosure of Invention

One object of the present invention is to eliminate the above problem and provide a soft crepe paper machine, which in a simple manner can be converted in order to be adapted to varying situ-

ations on the market, such as actual competitive situation and wishes from the consumers.

This object is achieved in that the paper machine is designed to be simple to rebuild between said first operative design and a second operative design for the manufacture of soft crepe paper having higher measurements of bulk and softness in relation to the first operative design, in which second operative design a conveying and imprinting fabric loop is substituted for the felt of the press section, air current generating means being provided along at least one of said fabrics for the removal of water from the paper web by flow of air of ambient temperature through the paper web carried by the fabric in question, cleaning means being provided along the conveying and imprinting fabric for the cleaning thereof so as to continuously maintain its permeability to water and air, and means being provided for depleting the conveying and imprinting fabric of water before the arrival thereof at said pick-up device.

Another object of the invention is to eliminate the above problem and provide a paper machine for the manufacture of a soft crepe paper grade, which in respect of bulk and softness is comparable to the one manufactured on a machine made for through-air drying by hot air.

This object is achieved in that the paper machine is provided with

- (a) a wire section including at least one forming fabric for forming a soft crepe paper web;
- (b) a drying section including a Yankee dryer for drying the web;
- (c) a press section located between the wire section and the drying section and including a conveying and imprinting fabric for conveying the web from the forming fabric to the Yankee dryer and a press roll for pressing the web on to the Yankee dryer while imprinting the web;
- (d) a pick-up device for picking up the web from the forming fabric and transferring the web to the conveying and imprinting fabric without any appreciable compaction of the web;
- (e) means for cleaning the conveying and imprinting fabric;
- (f) means for depleting the conveying and imprinting fabric of water before the arrival thereof at said pick-up device; and
- (g) air current generating means for removing water from the paper web by running a flow of air of ambient temperature through the paper web, said air current generating means having a capacity that is sufficient for raising the dry solids content of the paper web to at least 25% before the arrival of the paper web at the Yankee dryer.

Brief Description of the Drawings

The invention will below be explained more in detail with reference to the drawings, where

Fig. 1 schematically shows a preferred embodiment of a paper machine according to the invention for the manufacture of soft crepe paper.

Fig. 2 schematically shows a section of the paper machine according to Fig. 1 equipped with a single-felted press cooperating with a press roll located at the Yankee dryer.

Fig. 3 is a diagram illustrating the interrelation between density and basis weight of soft crepe paper manufactured in machines of two different operative designs.

Modes for Carrying Out the Invention

With reference to figure 1 there is schematically shown parts of a conventional paper machine suited for the manufacture of soft crepe paper, such as tissue and other sanitary paper products. The shown paper machine is a twin-wire machine including a wire section 1, a press section 3 and a drying section 5. Wire section 1 has a headbox 7, an endless carrying or inner forming fabric loop 9, an endless covering or outer forming fabric loop 11, and a forming roll 13 that may have a perforated surface and be equipped with internal suction apparatus or, alternatively, have a plain surface. Headbox 7 discharges a single layer or a multi-layer stock jet into a gap between the two moving forming fabrics 9, 11 for the forming of a paper web 15 by the drainage of water from the stock. The two forming fabrics run together over the forming roll 13 and then in individual loops over a plurality of rolls, which are arranged to guide, align and tension the carrying or inner forming fabric 9 and the covering or outer forming fabric, respectively. The rolls for the covering forming fabric 11 include a breast roll 17 and a guide roll 19, which is located a short distance downstream of the forming roll 13 and may be called a turning roll. The covering forming fabric 11 may leave the carrying forming fabric 9 and the paper web 15 either immediately before fabric 9 and paper web 15 run off from forming roll 13 or alternatively, when required or preferred, at a transfer suction box 21 or some other transferring device, which preferably operates by air flow, located between forming roll 13 and turning roll 19. The carrying forming fabric 9 runs up to press section 3, where the paper web 15 is transferred to press section 3 by means of a pick-up device 23 included in the press section.

Press section 3 has an endless looped movable fabric 25, which in a first operative design of the paper machine is a felt, that is a fabric provided with a fine fiber surface ("nap") of a natural or

synthetic material. The felt is arranged to convey paper web 15 from pick-up device 23 to a nip formed between a press roll 27 and a Yankee dryer 29 incorporated in the press section 5. Press roll 27 presses paper web 15 on to the jacket surface of Yankee dryer 29 simultaneously as felt 25 and press roll 27, which in this operative design of the machine preferably is a roll having a perforated surface, remove moisture from the paper web. After said nip felt 25 extends around a guide roll 31 and up to and through a second nip formed between a second press roll 33 and Yankee dryer 29, where felt 25 once more is pressed against paper web 15 to effect removal of any pattern caused by the perforated surface of the first press roll 27. Downstream of second press roll 33 there are means for cleaning and conditioning felt 25, which after the conditioning thereof should have a moisture content suited for the picking up of paper web 15 from carrying forming fabric 9.

Yankee dryer 29 is covered by a hood, not shown, in which hot air of high velocity is ejected against paper web 15. The paper web is creped off from Yankee dryer 29 by means of a creping doctor, not shown, in order to obtain a desired creping degree, whereupon the finished creped paper web is wound in a reel-up (not shown).

The second operative design of the paper machine is intended for the manufacture of a soft crepe paper having higher values of bulk and softness than what is obtainable in the paper machine according to the first operative design. To achieve this we substitute a conveying and imprinting fabric for felt 25. The use of imprinting fabrics in the manufacture of soft crepe paper, their functioning and the advantages achieved thereby are well known, cf. Pulp & Paper, November 1977, Hanson, J.P., "What's going on in tissue?", pages 93-102, especially pages 98 - 100 (Never underestimate knuckle power), for example. Further we provide air current generating means 35, 37 and 39 along at least one of carrying or inner forming fabric 9 and conveying and imprinting fabric 25 for removing water from paper web 15 by passing air of ambient temperature through the paper web 15 carried by the fabric in question, we provide cleaning means 41, 43 and 45 along conveying and imprinting fabric 25 for the cleaning thereof, so as to continuously maintain its permeability to water and air, and we provide means 47 for depleting conveying and imprinting fabric 25 of water before the fabric arrives at the pick-up device 23.

The conveying and imprinting fabric 25 can either run over the same rolls as the felt ran over, or guide roll 31 may be bypassed, so that the conveying and imprinting fabric runs from the first press roll 27, which in the second operative design preferably is roll having a plain surface, along the

jacket surface of Yankee dryer 29 directly to the second press roll 33. In both cases it is suitable that the second press roll 33 be taken out of pressing engagement with Yankee dryer 29, so that the paper web 15 will not be exposed to a second imprinting operation. The first imprinting operation is effected where the first press roll 27 presses paper web 15 on to Yankee dryer 29, and the pressing on is carried out with a force that preferably is at least 50 kN/m web width. If, however, in the second operative design the first press roll 27 is a roll having a perforated surface, e.g. a suction roll, it is suitable to expose the paper web 15 to a second imprinting operation by means of the second press roll 33 in order to remove the pattern that may be caused by the perforations of the first press roll 27.

For the paper machine in the second operative design to operate in the intended manner and produce a marketable soft crepe paper grade it is of utmost importance to maintain conveying and imprinting fabric 25 clean and, in addition, depleted of water upon its arrival at pick-up device 23. Because thereof, the cleaning equipment 41, 43, 45 is more extensive than what is required for cleaning and conditioning a felt in a conventional soft crepe paper machine and comprises a plurality of oscillating needle jet shower pipes 41, a plurality of fish-tail jet shower pipes 43 and a plurality of suction boxes 45. After installation of these shower pipes and suction boxes, they may, of course, be used also for the cleaning and conditioning of a felt, but then you do not normally use all of the shower pipes and the suction boxes. Two of the fish-tail jet shower pipes 43 are shown located and directed so as to produce a flooded nip where fabric 25 starts wrapping a guide roll. A flooded nip is particularly suitable for the cleaning and conditioning of a felt but is useful also for the cleaning of conveying and imprinting fabric 25.

A conditioned felt shall contain such an amount of water that the picking up of paper web 15 from forming fabric 9 is facilitated. In contrast hereto the conveying and imprinting fabric 25 is to be depleted of water by a water depleting means 47 upstream of the pick-up location. The water depleting means 47 suitably operates by means of an air flow passing through the conveying and imprinting fabric, and in the shown embodiment it is a suction box 47 but it would, of course, be possible to use alternatively a blow nozzle solely or in combination with the suction box. Suction box 47 and at least one of suction boxes 43 may suitably be mounted so as to make them easily movable between an active position, in which they engage fabric 25, and an inactive position, in which they do not, since they do not have to be active when fabric 25 is a felt. A plurality of shower water save-alls 49 are

provided for collecting the shower water passing through fabric 25 without being sucked into the cleansing suction boxes 45.

In a conventional paper machine the pick-up device may be a roll or shoe having a plain surface. For ensuring a picking up without any appreciable compaction of the paper web in the second operative design the pick-up device preferably should operate with air flow through forming fabric 9, paper web 15 and conveying and imprinting fabric 25 and it may comprise a suction device, e.g. a suction roll or, as shown in the preferred embodiment, a suction shoe 51. A still more improved effect is obtained if a blow nozzle 53 is provided inside the loop of the carrying forming fabric 9 and aligned with the suction zone of the shoe 51 or roll. The pick-up device 23 operating with air flow will work excellently also in the first operative design where fabric 25 is a felt. Then, blow nozzle 53 is not required for securing the picking up of paper web 15 from forming fabric 9.

In order to remove in the second operative design at least so much water from the newly formed moist paper web 15 without any appreciable compaction thereof that when the paper web is pressed on to the hot jacket surface of Yankee dryer 29 no steam bubble formation occurs, which would cause web 15 to come off the jacket surface in places, and also in order to reduce the drying capacity needed, air current generating means are provided for effecting a flow of air of ambient temperature through paper web 15. In the embodiment shown in figure 1 the air current generating means comprise two suction boxes 35, 37 located inside the loop of the carrying forming fabric 9 between transfer suction box 21 and pick-up device 23, and a suction box 39 located inside the loop of conveying and imprinting fabric 25 between pick-up device 23 and first press roll 27. The number of suction boxes 35, 37 and 39 and the location thereof between transfer suction box 21 and first press roll 27 may be varied within the scope of the present invention. However, it is necessary to pay attention to the moist and comparatively fragile soft crepe paper web not adhering too strongly to carrying forming fabric 9 or conveying and imprinting fabric 25. Means 55 may be provided, if desired, for applying a suitable release agent to conveying and imprinting fabric 25 for the purpose of reducing the adherence of web 15 to the fabric. Such means illustratively is a spraying device 55 located on the web facing side of fabric 25 immediately downstream of suction box 47. Conventional means, not shown, are also provided for forming and maintaining at an optimum and stable level a web adherence controlling coating on the jacket surface of the yankee dryer 29. A natural coating substantially consists of hemicellulose and fiber

fragments, but to improve control of the adhesive properties of the coating an adhesive agent and/or a release agent may be added. The amount of hemicellulose is controlled by controlling the pH of the stock, while the chemicals may be added to the stock or applied to the formed paper web or, preferably, directly onto the jacket surface of the yankee dryer. The adhesion of the web to the coating affects all properties of the paper web, and the coating also affects the wear of the yankee dryer surface and of the doctor blade.

Some dewatering of paper web 15 also ensues due to the flow of air into transfer suction box 21 and suction shoe 51. In order to improve the dewatering still more a steam box 61 for heating paper web 15 by means of direct steam may be provided immediately upstream of suction box 35 and on the web carrying side of forming fabric 9. The heating reduces the viscosity of the water, so that it will be easier to suck it out. In addition, the dewatering rate will be increased by the sucking through of air. If desired it is, of course, possible to provide in a corresponding manner a second steam box, not shown, for heating web 15 by direct steam immediately upstream of suction box 39 located inside the loop of the conveying and imprinting fabric 39. In order to shield paper web 15 from condensate drippings and possible splashes of water when carried hanging on the underside of conveying and imprinting fabric 25, a web-covering heatable roof or shield element 63 is placed above the lower run or flight of the conveying and imprinting fabric. Roof element 63 may be provided with conduits, not shown, for conducting hot water or steam therethrough but may also be heated in some other way, e.g. by electricity.

In order to avoid the above mentioned formation of steam bubbles between paper web 15 and Yankee dryer 29, the paper web should have a dry solids content of at least about 25 % when the first press roll 27 presses web 15 on to Yankee dryer 29. The number of paper web dewatering suction boxes 35, 37 and 39, the flow of air through web 15, and the possible heating by direct steam are adjusted so as to achieve the aforesaid dry solids content. As a supplement to or a substitute for the heating by direct steam, heating by infrared (IR) radiation may be used, e.g. from one or more hood-type IR heaters, not shown, or other equipment able to emit IR radiation. Hood-type IR heaters may also be used for facilitating the drying of paper web 15 on Yankee dryer 29, and in figure 1 there is shown one such IR hood 65 placed somewhat downstream of second press roll 33. A compact standard hood having a single row of IR elements can emit about 125 kW/m web width.

Usually, paper web 15 reaches a dry solids content of about 25-30% already on forming fabric

9, and the dry solids content is increased by one or several more percent along conveying and imprinting fabric 25. If it is desired to raise the dry solids content of web 15 still more before the web is pressed on to Yankee dryer 29, it is possible to supplement the paper machine with a conventional single-felted press, as shown schematically in figure 2.

In figure 2 the conveying and imprinting fabric 25, which on its under side carries paper web 15, runs from the bottom side of first press roll 27 up to and around a turning roll 67, from where it runs to the press nip formed between first press roll 27 and Yankee dryer 29. Press roll 27 constitutes a counter roll of a conventional single-felted press, generally indicated by 69, having a press roll 71 and an endless felt 73 running over a plurality of rolls 75. A suction box 77 is provided inside the loop of conveying and imprinting fabric 25 upstream of turning roll 67 for securing that paper web 15 will not be transferred to press felt 73 but will remain adhered to conveying and imprinting fabric 25. Such a conventional single-felted press will raise the dry solids content of paper web 15 by up to an additional five percent.

In a modification (not shown) of the singlefelted press of Fig. 2, the lower press roll 71 is moved from its illustrated 6 o'clock position in relation to press roll 27 to a 7 o'clock position. This makes it possible to leave out turning roll 67 and suction box 77. After passing from the nip formed between press roll 27, 71, the conveying and imprinting fabric 25, carrying the paper web 15, will then follow the surface of press roll 27 up to the nip formed by roll 27 with yankee dryer 29. From the press nip formed by rolls 27, 71 at the 7 o'clock position the press felt 73 will be run to the 6 o'clock position, and then will pass tangentially and horizontally from roll 27. Consequently, paper web 15 will not be transferred to the press felt 73, but will instead remain adhered to the bottom side of conveying and imprinting fabric 25 when the latter passes upwardly on press roll 27.

In order not to unnecessarily crowd the drawing with details, which merely show conventional equipment in paper machines and do not constitute any part of the present invention, such details are omitted. Examples of such non-shown details are cleaning devices for forming fabrics 9 and 11 and for press felt 73, and further, white water save-alls and devices for stretching, aligning and driving the various endless fabrics.

Figure 3 is a diagram showing density as a function of basis weight for soft crepe paper manufactured on one hand in a conventional paper machine according to the first operative design and on the other hand in the same machine after a rebuilding thereof to the second operative design. A sin-

gle-felted press in accordance with the variant shown in figure 2 was not used. Consequently, the upper line 79 relates to a soft crepe paper manufactured in the conventional manner, and the lower line 81 relates to soft crepe paper manufactured in the rebuilt machine, where the conveying and imprinting fabric was substituted for the pick-up felt, and where water was removed from the paper web by passing air of ambient temperature through the web in an amount sufficient for raising the dry solids content of the paper web to at least about 25% before the paper web arrived at the Yankee dryer. As is apparent from the diagram, the latter soft crepe paper 81 has a density, which at low basis weights is about half the density of the conventional soft crepe paper, and the percentage difference increases with increasing basis weight. Since bulk is inverted density, a density of 200 kg/m³, for example, corresponds to a bulk of 5 dm³/kg, and a density of 80 kg/m³ corresponds to a bulk of 12.5 dm³/kg, the soft crepe paper in accordance with line 81 has at low basis weights twice as high a bulk as conventional soft crepe paper and the percentage difference in bulk increases with increasing basis weight.

The density of soft crepe paper manufactured in a conventional through-air drying machine using hot air is essentially of the same order as that indicated by the lower line 81. The bulk of a soft crepe paper grade in accordance with the lower line 81 consequently is fully comparable to the one manufactured in a through-air drying machine utilizing hot air. While the softness has not been measured, it is well known that the softness increases with increasing bulk of the soft crepe paper. The increased softness is appreciated by consumers but in some cases can result in adaptation problems during conversion of the soft crepe paper web to the desired end products.

The rebuilding required for converting the paper machine according to the invention from one operative design into the other essentially consists of a change from pick-up felt into conveying and imprinting fabric or the reverse. What is additionally required is that certain components, e.g. second press roll 33, water depleting suction box 47 and possibly one of the suction boxes 45 of the cleaning means for conveying and imprinting fabric 25, are changed from an inactive to an active position, and that other components, such as one or more of shower pipes 41, 43 and the possible device 55 for applying a release agent on to the conveying and imprinting fabric, are activated or inactivated. In addition it is preferred, but not absolutely required, in cases where the first press roll has a perforated surface, to substitute for said roll a roll having a plain surface. The time required for the rebuilding will as a consequence, be short. The rebuilding

should be finished in only a slightly longer time (about 12 hours or less) as is needed for changing the pick-up felt in a conventional soft crepe paper machine.

The cost of converting an existing old soft crepe paper machine into paper machine according to the present invention is estimated to be 10-20% of the price of a new through-air drying machine. Thus, for a comparatively low machine cost a soft crepe paper manufacturer can produce a soft crepe paper grade, which with regard to bulk and softness is fully comparable to the one manufactured in a machine using through-air drying by hot air. Roughly, the production will be halved, since a large part of the dewatering is carried out by through-flow of air of ambient temperature followed by drying on the Yankee dryer, which requires a considerably lower machine speed, about half of that of a conventional soft crepe paper machine, but production costs for the produced high bulk soft crepe paper will be of the same order as with production in a through-air drying machine. A look at the costs of the end-product sold to the consumer, e.g. a package of paper handkerchiefs, shows that the change-over from conventional handkerchief paper to high bulk handkerchief paper produced in the paper machine according to the invention gives the possibility of such savings in the amount of paper fibres used, that the cost for the finished product can be reduced. In addition, the consumer will get a softer and more attractive product.

The fact that it is possible to produce in a conventional soft crepe paper machine a soft crepe paper without having to use a pick-up felt must be characterized as unexpected. In addition it was unexpected that the soft crepe paper grade produced in the machine according to the invention should be fully comparable, in respect of bulk and softness, to the one produced in a paper machine made for through-air drying by hot air.

The invention has been described above with reference to a twin-wire former of C-wrap type but, of course, it can be applied also in other formers, e.g. twin-wire formers of S-wrap type, fourdrinier formers and suction breast roll formers.

Claims

1. A paper machine for the manufacture of soft crepe paper and including a wire section (1), which has at least one forming fabric loop (9) for forming a paper web (15), and a drying section (5) including a Yankee dryer (29), in which drying section the paper web (15) is dried, said paper machine having a first operative design for the manufacture of soft crepe paper having certain measurements of bulk

- and softness, in which first operative design a press section (3) located between the wire section (1) and the drying section (5) has a felt (25) movable in an endless loop and arranged to run from a pick-up device (23) located at a transition between the wire section (1) and the press section (3) to a press roll (27) forming a nip with the Yankee dryer (29) while carrying the paper web (15) on its underside, the carrying forming fabric (9) being arranged to run up to said pick-up device (23) in the press section (3) for the transfer of the formed paper web (15) to said felt (25), **characterized in that** the paper machine is designed to be simple to rebuild between said first operative design and a second operative design for the manufacture of soft crepe paper having higher measurements of bulk and softness in relation to the first operative design, in which second operative design a conveying and imprinting fabric loop (25) is substituted for the felt (25) of the press section (3), air current generating means (35,37,39) being provided along at least one of said fabrics (9,25) for the removal of water from the paper web (15) by flow of air of ambient temperature through the paper web (15) carried by said fabric, cleaning means (41,43,45) being provided along the conveying and imprinting fabric (25) for the cleaning thereof so as to continuously maintain its permeability to water and air, and means (47) being provided for depleting the conveying and imprinting fabric (25) of water before the arrival thereof at said pick-up device (23).
2. A paper machine according to claim 1, wherein in the first operative design there is provided a second press roll (33), which downstream of the first mentioned press roll (27) forms a second nip with the Yankee dryer (29), and wherein the felt after the first mentioned nip runs over a guide roll (31) to and through the second nip, where it is pressed against the paper web (15), **characterized in that** in the second operative design the second press roll (33), in case the first press roll (27) has a plain surface, is lifted out of pressing contact with the Yankee dryer (29), so that a second imprinting of the paper web (15) is avoided.
 3. A paper machine for the manufacture of a soft crepe paper grade, including:
 - (a) a wire section (1) having at least one forming fabric (9) for forming a soft crepe paper web (15);
 - (b) a drying section (5) having a Yankee dryer (29) for drying the web (15);
 - (c) a press section (3) located between the wire section (1) and the drying section (5) and having a conveying fabric (25) for conveying the web (15) from the forming fabric (9) to the Yankee dryer (29) and a press roll (27) for pressing the web (15) on to the Yankee dryer (29); and
 - (d) a pick-up device (23) for picking up the web (15) from the forming fabric (9) and transferring the web (15) to the conveying fabric (25) without any appreciable compaction of the web (15);**characterized in that** for the manufacture of a soft crepe paper grade, which in respect of bulk and softness is comparable to a grade manufactured on a machine made for through-air drying by hot air, the conveying fabric is a conveying and imprinting fabric (25) for imprinting the web (15) when the web is pressed on to the Yankee dryer (29) by the press roll (27), said machine further including:
 - (e) means (41,43,45) for cleaning the conveying and imprinting fabric (25);
 - (f) means (47) for depleting the conveying and imprinting fabric (25) of water before the arrival thereof at said pick-up device (23); and
 - (g) air current generating means (35,37,39) for removing water from the paper web (15) by running a flow of air of ambient temperature through the paper web (15), said air current generating means (35,37,39) having a capacity that is sufficient for raising the dry solids content of the paper web to at least 25% before the arrival of the paper web (15) at the Yankee dryer (29).
 4. A paper machine according to any one of claims 1-3, **characterized by** said pick-up device (23) picking up said web (15) pneumatically.
 5. A paper machine according to claim 4, **characterized by** said pick-up device (23) including a suction member (51) located inside the conveying and imprinting fabric loop (25) for picking up the paper web (15) from the forming fabric and transferring the web (15) to the conveying and imprinting fabric (25) without appreciably compacting the web (15).
 6. A paper machine according to claim 5, **characterized by** said pick-up device (23) including a blow nozzle (53) located inside the forming fabric loop (9) and aligned with a suction opening provided in the suction member (51).

7. A paper machine according to any one of claims 1-6, **characterized by** said air current generating means including at least one suction box (35,37,39).
8. A paper machine according to claim 7, **characterized by** a steam box (61) for heating the moist paper web (15) by means of direct steam and located immediately upstream of the suction box (35) and on the web carrying side of the fabric (9).
9. A paper machine according to any one of the preceding claims, **characterized by** at least one hood-type IR heater (65) for IR heating of the paper web (15).
10. A paper machine according to claim 9, **characterized by** said IR hood (65) being located at the Yankee dryer (29) downstream of the press roll (27).
11. A paper machine according to any one of claims 1-10, **characterized by** said press roll (27) constituting a counter roll in a single felted press (69) for additional dewatering of the web (15) before the press roll (27) presses the web (15) on to the Yankee dryer (29).
12. A paper machine according to any one of claims 1-11, **characterized by** a heatable roof element (63) located above the lower run of the conveying and imprinting fabric (25) for protecting the paper web against splashes of water and condensate drippings.
13. A paper machine according to any one of claims 1-12, **characterized by** means (55) for applying a web adherence reducing release agent to the conveying and imprinting fabric (25).

Patentansprüche

1. Papiermaschine für die Herstellung von weichem Krepppapier, mit einer Siebpartie (1), wobei die Maschine mindestens eine Formiersiebschleife (9) zur Bildung einer Papierbahn (15) und eine Trockenpartie (5) einschließlich eines Kreppzylinders (29), in welcher die Papierbahn (15) getrocknet wird aufweist, wobei diese Papiermaschine eine erste Ausführungsform für die Herstellung von weichem Krepppapier mit bestimmten Werten des spezifischen Volumens und der Weichheit hat, bei welcher eine Pressenpartie (3), die sich zwischen der Siebpartie (1) und der Trockenpartie (5) befindet, einen Filz (25) besitzt, der in einer endlo-

sen Schleife beweglich und so angeordnet ist, daß er von einer Abnahmevorrichtung (23), die sich an einem Übergang zwischen der Siebpartie (1) und der Pressenpartie (3) befindet, zu einer Preßwalze (27) läuft, die mit dem Kreppzylinder (29) einen Preßspalt bildet, während er die Papierbahn (15) an seiner Unterseite trägt, wobei das tragende Formiersieb (9) so angeordnet ist, daß es zur Abnahmevorrichtung (23) in der Pressenpartie (3) zwecks Übergabe der gebildeten Papierbahn (15) an den erwähnten Filz (25) läuft, **dadurch gekennzeichnet**, daß die Papiermaschine so konstruiert ist, daß ihr Umbau einfach ist zwischen der ersten Ausführungsform und einer zweiten Ausführungsform für die Herstellung von weichem Krepppapier mit im Vergleich zur ersten Ausführungsform höheren Werten des spezifischen Volumens und der Weichheit, wobei in dieser zweiten Ausführungsform eine Schleife des Transport- und Prägesiebs (25) den Filz (25) der Pressenpartie (3) ersetzt, mit Mitteln (35, 37, 39) zur Erzeugung einer Luftströmung, die längs zumindest eines der Siebe (9, 25) zwecks Entfernung von Wasser aus der Papierbahn (15) durch Strömung von Luft bei Umgebungstemperatur durch die von diesem Sieb getragene Papierbahn (15) hindurch vorhanden sind, mit Mitteln (41, 43, 45) zur Reinigung längs des Transport- und Prägesiebs (25) zwecks Reinigung desselben, um seine Wasser- und Luftdurchlässigkeit ständig aufrechtzuerhalten und mit Mitteln (47) zum Entziehen von Wasser aus dem Transport- und Prägiesieb (25), bevor es die Abnahmevorrichtung (23) erreicht.

2. Papiermaschine nach Anspruch 1, bei welcher in der ersten Ausführungsform eine zweite Preßwalze (33) vorhanden ist, die stromabwärts der ersten, erwähnten Preßwalze (27) mit dem Kreppzylinder (29) einen zweiten Preßspalt bildet, und bei welcher der Filz (25) nach dem ersten, erwähnten Preßspalt über eine Leitwalze (31) auf den zweiten Preßspalt zu und durch ihn hindurch läuft, wo er gegen die Papierbahn (15) gedrückt wird, **dadurch gekennzeichnet**, daß bei der zweiten Ausführungsform die zweite Preßwalze (33) falls die erste Preßwalze (27) eine glatte Oberfläche hat von dem Preßkontakt mit dem Kreppzylinder (29) weg gehoben ist, so daß ein zweites Prägen der Papierbahn (15) vermieden wird.
3. Papiermaschine für die Herstellung einer weichen Krepppapierqualität, mit:
 - a) einer Siebpartie (1), die mindestens ein Formiersieb (9) für die Bildung einer Bahn

aus weichem Krepppapier (15) besitzt;

b) einer Trockenpartie (5) mit einem Kreppzylinder (29) zum Trocknen der Bahn (15);

c) einer Pressenpartie (3), die sich zwischen der Siebpartie (1) und der Trockenpartie (5) befindet und ein Transportsieb (25) zur Beförderung der Bahn (15) von dem Formiersieb (9) zu dem Kreppzylinder (29) sowie eine Preßwalze (27) zum Pressen der Bahn (15) gegen den Kreppzylinder (29) besitzt, und

d) einer Abnahmevorrichtung (23) zur Entnahme der Bahn (15) von dem Formiersieb (9) und zum Übergeben der Bahn (15) auf den Transportsieb (25) ohne nennenswertes Verdichten der Bahn (15);

dadurch gekennzeichnet, daß zur Herstellung einer weichen Krepppapierqualität, die in bezug auf spezifischen Volumen und Weichheit mit einer auf einer für die Durchströmungstrocknung mit Heißluft konstruierten Maschine hergestellten Qualität vergleichbar ist, das Transportsieb ein Transport- und Prägesieb (25) ist, das die Bahn (15) prägt, wenn die Bahn von der Preßwalze (27) gegen den Kreppzylinder (29) gepreßt wird, wobei die erwähnte Maschine außerdem folgendes aufweist:

e) Mittel (41, 43, 45) für die Reinigung des Transport- und Prägesiebs (25);

f) Mittel (47) zur Entnahme von Wasser aus dem Transport- und Prägesieb (25), bevor es an der Abnahmevorrichtung (23) anlangt, und

g) Mittel (35, 37, 39) für das Erzeugen einer Luftströmung zum Entfernen von Wasser aus der Papierbahn (15) durch das Strömen von Luft bei Umgebungstemperatur durch die Papierbahn (15) hindurch, wobei diese Mittel (35, 37, 39) fürs Erzeugen einer Luftströmung eine Leistung haben, die ausreicht, um den Trockengehalt der Papierbahn (15) auf mindestens 25 % steigen zu lassen, bevor die Papierbahn (15) an dem Kreppzylinder (29) anlangt.

4. Papiermaschine nach irgend einem der Ansprüche 1-3, **dadurch gekennzeichnet**, daß die Abnahmevorrichtung (23) die Bahn (15) pneumatisch aufnimmt.

5. Papiermaschine nach Anspruch 4, **dadurch gekennzeichnet**, daß die Abnahmevorrichtung (23) ein Saugelement (51) aufweist, das sich innerhalb der von dem Transport- und Prägesieb (25) gebildeten Schleife befindet, um die Papierbahn (15) dem Formiersieb zu entnehmen und die Bahn (15) auf das Transport- und

Prägesieb (25) zu übertragen, ohne dabei die Bahn (15) nennenswert zu verdichten.

6. Papiermaschine nach Anspruch 5, **dadurch gekennzeichnet**, daß die Abnahmevorrichtung (23) eine Blasdüse (53) aufweist, die sich innerhalb der Formiersiebschleife (9) befindet und gegenüber einer Saugöffnung steht, die das Saugelement (51) aufweist.

7. Papiermaschine nach irgend einem der Ansprüche 1-6, **dadurch gekennzeichnet**, daß die erwähnten Mittel für die Erzeugung einer Luftströmung mindestens einen Saugkasten (35, 37, 39) einschließen.

8. Papiermaschine nach Anspruch 7, **dadurch gekennzeichnet**, daß sie einen Dampfkasten (61) zum Aufwärmen der feuchten Papierbahn (15) durch direkte Einwirkung von Dampf aufweist, der sich unmittelbar stromaufwärts des Saugkastens (35) und auf derjenigen Seite des Siebs (9) befindet, die die Bahn trägt.

9. Papiermaschine nach irgend einem der Ansprüche 1-8, **dadurch gekennzeichnet**, daß sie wenigstens einen IR-Heizgerät (65) des Typs mit Haube zum IR-Wärmen der Papierbahn (15) aufweist.

10. Papiermaschine nach Anspruch 9, **dadurch gekennzeichnet**, daß sich die IR-Haube (65) an dem Kreppzylinder (29) stromabwärts von der Preßwalze (27) befindet.

11. Papiermaschine nach irgend einem der Ansprüche 1-10, **dadurch gekennzeichnet**, daß die Preßwalze (27) eine Gegenwalze in einer Einzelfilzpresse (69) darstellt, und zwar zwecks zusätzlichen Entzuges von Wasser aus der Bahn (15), bevor die Preßwalze (27) die Bahn (15) gegen den Kreppzylinder (29) preßt.

12. Papiermaschine nach irgend einem der Ansprüche 1-11, **dadurch gekennzeichnet**, daß sie ein heizbares Dachelement (63) aufweist, das oberhalb des unteren Trums des Transport- und Prägesiebes (25) angebracht ist, um die Papierbahn gegen Spritzwasser und das Tropfen von Kondenswasser zu schützen.

13. Papiermaschine nach irgend einem der Ansprüche 1-12, **dadurch gekennzeichnet**, daß sie ein Mittel (55) zum Auftragen auf das Transport- und Prägesieb (25) eines Trennmittels zur Herabsetzung der Haftung der Bahn aufweist.

Revendications

1. Machine à papier destinée à la fabrication de papier à usages sanitaires et domestiques et comprenant une partie à toile (1), ayant au moins une boucle de toile (9) de mise en bande pour la formation d'une bande de papier (15), et une partie séchage (5) qui comprend un cylindre sécheur (29), partie séchage dans laquelle la bande de papier (15) est séchée, cette machine à papier ayant un premier mode de réalisation pour la fabrication de papier à usages sanitaires et domestiques ayant certaines caractéristiques d'indice de bouffant et de douceur, premier mode de réalisation avec lequel une section des presses (3) située entre la partie à toile (1) et la partie séchage (5) a un feutre (25) qui peut se déplacer selon une boucle sans fin et qui est disposée pour aller d'un dispositif de prise (23), situé à une transition entre la partie à toile (1) et la section des presses (3), à un rouleau de presse (27) qui forme une zone de pression avec le cylindre sécheur (29) quand elle porte la bande de papier (15) sur sa face inférieure, la toile de mise en bande porteuse (9) étant disposée pour aller au dispositif de prise (23) dans la section des presses (3) pour le transfert au feutre (25) de la bande de papier (15) formée, **caractérisée en ce** que la machine à papier est conçue pour être simple à modifier pour passer du premier mode de réalisation au deuxième et inversement, ce deuxième mode de réalisation étant destiné à la fabrication de papier à usages sanitaires et domestiques ayant des caractéristiques plus élevées d'indice de bouffant et de douceur qu'avec le premier mode de réalisation et remplaçant le feutre (25) de la section des presses (3) par une boucle de toile de transport et de gaufrage (25), des moyens de production d'un courant d'air (35, 37, 39) étant placés le long d'au moins l'une des toiles (9, 25) pour éliminer de l'eau de la bande de papier (15) par le passage d'un courant d'air à la température ambiante à travers la bande de papier (15) portée par la toile mentionnée, avec des moyens de nettoyage (41, 43, 45) le long de la toile de transport et de gaufrage (25) pour nettoyer celle-ci afin de maintenir en permanence sa perméabilité à l'eau et à l'air, et avec un moyen (47) de retirer de l'eau de la toile de transport et de gaufrage (25) avant que cette dernière n'arrive au dispositif de prise (23).
2. Machine à papier suivant la revendication 1, dans laquelle le premier mode de réalisation comporte un deuxième rouleau de presse (33) qui, en aval du premier rouleau de presse mentionné (27), forme une deuxième zone de pression avec le cylindre sécheur (29) et dans laquelle le feutre, après la première zone de pression mentionnée, passe sur un rouleau guide (31) pour aller à la deuxième zone de pression et la traverser, zone où il est pressé contre la bande de papier (15), **caractérisée en ce** que, pour le deuxième mode de réalisation, le deuxième rouleau de presse (33), dans le cas où le premier rouleau de presse (27) a une surface unie, est soulevé de manière à faire cesser son contact de pression avec le cylindre sécheur (29), de telle sorte qu'un deuxième gaufrage de la bande de papier (15) est évité.
3. Machine à papier destinée à la fabrication d'une qualité de papier à usages sanitaires et domestiques, comprenant:
 - a) une partie à toile (1) ayant au moins une toile de mise en bande (9) pour former une bande de papier à usages sanitaires et domestiques (15);
 - b) une section de séchage (5) comportant un cylindre sécheur (29) pour sécher la bande de papier (15);
 - c) une section des presses (3) située entre la partie à toile (1) et la section de séchage (5) et comportant une toile de transport (25) pour transporter la bande (15) de la toile de mise en bande (9) au cylindre sécheur (29) et un rouleau de presse (27) pour presser la bande (15) contre le cylindre sécheur (29), et
 - d) un dispositif de prise (23) pour prendre la bande (15) sur la toile de mise en bande (9) et faire passer la bande (15) sur la toile de transport (25) sans compression notable de la bande (15), **caractérisée en ce** que, pour la fabrication d'une qualité de papier à usages sanitaires et domestiques qui, en ce qui concerne l'indice de bouffant et la douceur, soit comparable à une qualité fabriquée sur une machine construite pour le séchage par passage transversal d'air chaud, la toile de transport est une toile de transport et de gaufrage (25) servant à gaufrer la bande (15) quand cette bande est pressée contre le cylindre sécheur (29) par le rouleau de presse (27), cette machine comprenant en outre:
 - e) des moyens (41, 43, 45) de nettoyage de la toile de transport et de gaufrage (25);
 - f) un moyen (47) pour retirer de l'eau de la toile de transport et de gaufrage (25) avant qu'elle n'arrive au dispositif de prise (23) mentionné, et

- g) des moyens (35, 37, 39) de production d'un courant d'air pour retirer de l'eau de la bande de papier (15) en faisant passer un courant d'air à la température ambiante à travers la bande de papier (15), ces moyens de production d'un courant d'air (35, 37, 39) ayant une capacité suffisante pour faire passer à au moins 25 % la teneur en matière sèche de la bande de papier avant que la bande de papier (15) ne parvienne au cylindre sécheur (29).
4. Machine à papier suivant l'une quelconque des revendications 1 à 3, **caractérisée en ce** que le dispositif de prise (23) prend la bande (15) pneumatiquement.
5. Machine à papier suivant la revendication 4, **caractérisée en ce** que le dispositif de prise (23) comprend un élément d'aspiration (51) placé à l'intérieur de la boucle de la toile de transport et de gaufrage (25), pour prendre la bande de papier (15) sur la toile de mise en bande et transférer la bande de papier (15) sur la toile de transport et de gaufrage (25) sans compression notable de la bande (15).
6. Machine à papier suivant la revendication 5, **caractérisée en ce** que le dispositif de prise (23) comporte une buse de soufflage (53) située à l'intérieur de la boucle (9) de la toile de mise en bande et alignée sur une ouverture d'aspiration qui se trouve dans l'élément d'aspiration (51).
7. Machine à papier suivant l'une quelconque des revendications 1 à 6, **caractérisée en ce** que les moyens de production d'un courant d'air comprennent au moins une caisse d'aspiration (35, 37, 39).
8. Machine à papier suivant la revendication 7, **caractérisée en ce** qu'elle comprend une caisse à vapeur (61) servant à chauffer la bande de papier (15) humide par l'action directe de la vapeur, et placée immédiatement en amont de la caisse aspirante (35), du côté de la toile (9) qui porte la bande.
9. Machine à papier suivant l'une quelconque des revendications précédentes, **caractérisée en ce** qu'elle est équipée d'au moins un radiateur à infrarouges (65) du type à hotte pour chauffer la bande de papier (15) aux rayons infrarouges.
10. Machine à papier suivant la revendication 9, **caractérisée en ce** que la hotte à infrarouges (65) est située près du cylindre sécheur (29), en aval du rouleau de presse (27).
11. Machine à papier suivant l'une quelconque des revendications 1 à 10, **caractérisée en ce** que le rouleau de presse (27) constitue un rouleau antagoniste dans une presse à un feutre (69) servant à une élimination supplémentaire d'eau de la bande de papier (15) avant que le rouleau de presse (27) ne presse la bande (15) contre le cylindre sécheur (29).
12. Machine à papier suivant l'une quelconque des revendications 1 à 11, **caractérisée en ce** qu'elle comprend un élément de couverture (63) pouvant être chauffé, situé au-dessus de la branche inférieure de la toile de transport et de gaufrage (25) afin de protéger la bande de papier (15) contre les projections d'eau et la chute de gouttes d'eau de condensation.
13. Machine à papier suivant l'une quelconque des revendications 1 à 12, **caractérisée en ce** qu'elle comprend un moyen (55) d'application à la toile de transport et de gaufrage (25) d'un produit de décollement réduisant l'adhérence à la toile.

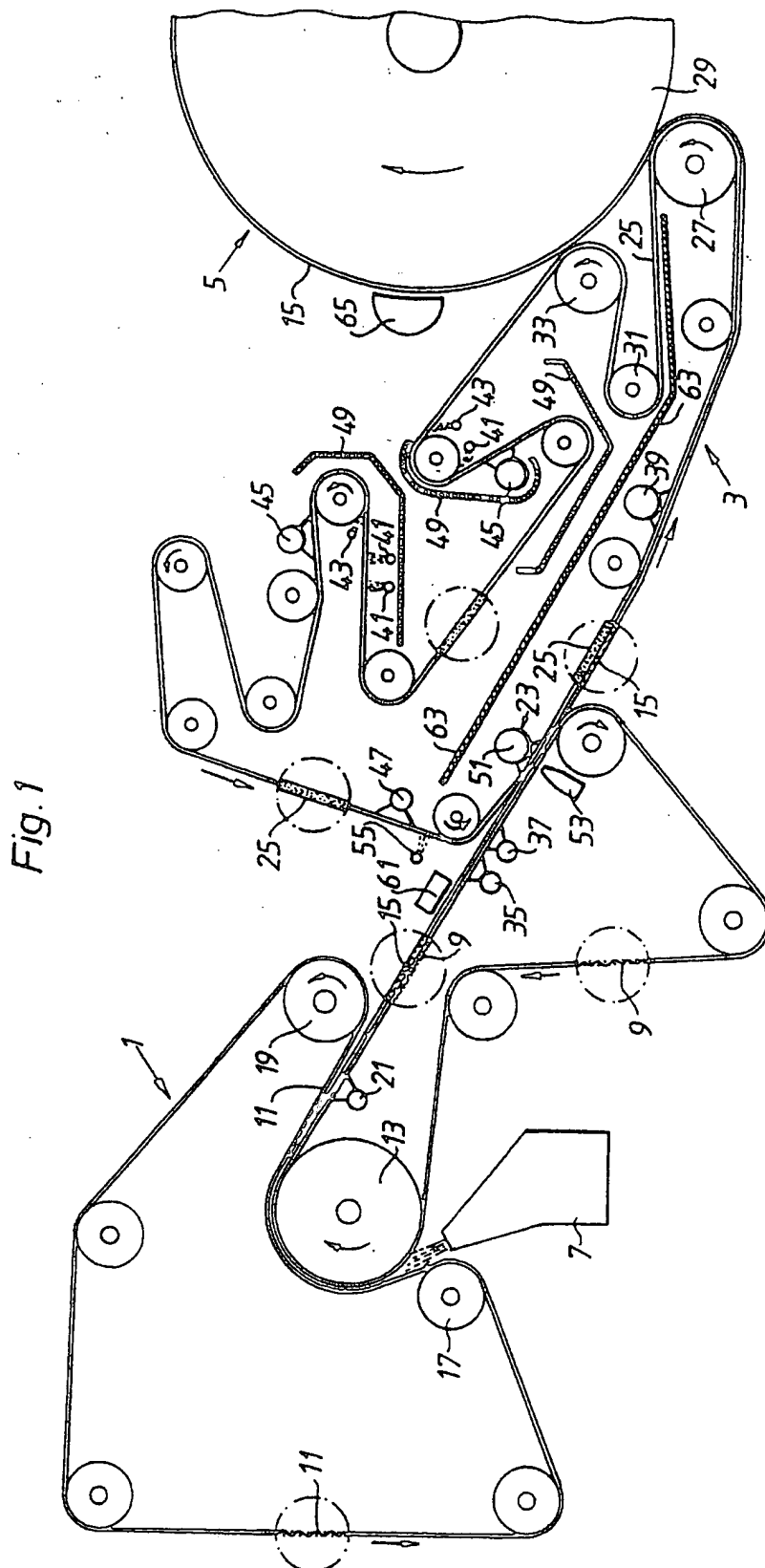


Fig. 2

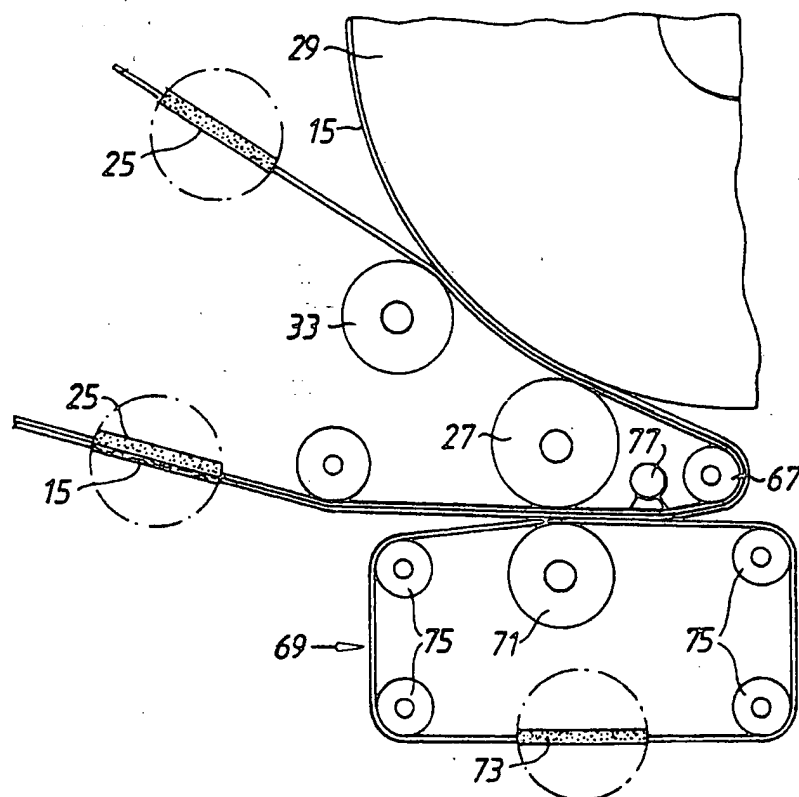


Fig. 3

